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III. *Extract of a Letter from Mr. Jos. Nic. Del'Isle, F.R. S. to John Machin, Secr. R. S. & Pr. Astr. Gresb. Dated Petersburg,  $\frac{6}{17}$  Feb. 173 $\frac{2}{3}$ , containing several Literary Communications concerning the Construction of a Quick-silver Thermometer, and his Observations on the Eclipses of Jupiter's Satellites, Annis 1731, and 1732. Translated from the French by Phil. Henry Zollman. F. R. S.*

IN order to have more sure Grounds for my Experiments of Natural Philosophy in this Country, and that they might be compared with those of other Countries, I applied myself this Winter to the Construction of Thermometers of *Mercury*, regulated by the Expansion of that Fluid proportionably to its bulk. This Expansion is indeed not very perceptible, considering that Dr. *Halley* in the Experiments made by him upon it above 40 Years ago, which are related in *Numb. 197, of the Philosophical Transactions*; found, that the said Expansion, by the Heat of boiling Water, was no more than  $\frac{1}{74}$  Part of the bulk of *Mercury*, the Experiment having been tried in the Months of *February* and *March*, when the Weather was cold enough, though it did not freeze.

M. *Amontons*, a Member of the Academy of Sciences at *Paris*, also relates in the Memoirs of that Academy of the Year 1704, that this Expansion of the *Mercury*, is but  $\frac{1}{115}$  Part of its Bulk from the greatest Heat to the greatest Cold that is felt at *Paris*. For my own part, I found in the great Cold, we had here this Winter on the  $\frac{16}{27}$  *January* last in the Morning, that the Bulk of the *Mercury* was condensed almost  $\frac{1}{50}$  Part of the Extent it had in boiling Water. The Cold we had that Day, the Wind being at East, was one of the severest that ever was felt here. I shall give you a more exact Account of it hereafter, when I have compared my new Thermometers with those ordinary Ones I made use of for these four or five Years past. My new Thermometers of *Mercury* I had made of a good large Size, and in such Manner that, having divided in each the whole Quantity of *Mercury* it contains into one hundred thousand Parts; and having mark'd the Extent of the bulk of that *Mercury* in boiling Water, I can at any time see on the Divisions of these Thermometers, by how many Parts the Bulk of the *Mercury* is condensed through the present Temperature of the Air. And though I have made four of these Thermometers, which differ very much as to their Size, and the Quantity of *Mercury* they contain, yet they agree within a very few of these Parts. As pure *Mercury* is of the same Nature every where, nor is liable to any alteration from being enclosed in a Tube; and as it is probable, that taking it equally purified, it will in different Countries be subject to the same Expansion, if expos'd to the same Degree of Heat; for this

Reason

Reason I am persuaded these Thermometers may very well serve to compare the Temperature of different Countries; the rather, as I found by Experience, that these Thermometers may be rendered fit enough to mark sensibly the Increase, or Diminution of the Bulk of the *Mercury*, within one or two Parts out of the 100,000 contained in the whole Bulk. This Sort of Thermometers has also this advantage, that as they mark the proper Expansion of the *Mercury* in each Temperature of Air, they may serve to shew every Moment the Correction that is to be made in the Height of the *Mercury* in simple Barometers; which will serve for reducing them to the Height they would have in an equal Temperature of Air: And one might, for this End, chuse and agree upon the Heat of boiling Water, as a fixed Term, which, in all appearance, will be the same all over the World. If the Royal Society should approve this new Construction of Thermometers, and should order some of their Members to make the like, we might hereafter be able exactly to compare the Temperature of *England* with that of this Country, and other Places where the like Thermometers should be made. In order to reap this Advantage from my Experiments, I shall communicate to the Royal Society all the Observations I have made here for these four or five Years past, on the Barometer and Thermometer, as soon as I shall have adapted them to the Effect which I just now said that Heat and Cold produce upon the *Mercury*. I am informed, that four or five Years ago, the Royal Society sent to M. *Abraham Vater* at *Wittenberg*, large Thermometers of Spirit of Wine,

made and regulated by an Instrument-Maker of the Royal Society, in order to compare the Observations to be made in *Germany*, by the Means of those Thermometers, with the Observations made in *England* by the like Thermometers, the one being regulated by the others. M. *Weidler*, Professor of Mathematicks at *Wittenberg*, mentions in the Account which he gave of his Meteorological Observations for the Year 1729, that he has furnished himself with one, which he intends to make use of hereafter for his Meteorological Observations. He also says, that the Observers of the Royal Society of *Berlin*, make use of a like Thermometer; and I have myself received from thence, Observations on the Heights of the Thermometer of Spirit of Wine, made probably with that Instrument, for the whole Year 1729, and for the first three Months of 1731. Those Observations are engraved on Copper Plates, where the Heights of the Spirit of Wine are expressed in Parts of the *French, English, and Rhinland* Foot. If the Royal Society approve of this Sort of Thermometers, and are desirous I should compare them with mine; if they also desire that Meteorological Observations with those Thermometers of Spirit of Wine should be made in *Russia*, I beg you would send me several of them; but then I beg that those you send me, be well regulated, and exactly compared with those the Observers of the Royal Society make use of; supposing that some Person or other of their Body is appointed to keep Journals of these Observations. I shall send in exchange to the Royal Society, if they desire it, some Thermometers of *Mercury* regulated  
by

by and compared with the four large ones which I made here.

It was a great Pleasure to me, to see by N<sup>o</sup>. 419. of the *Philosophical Transactions*, that Mr. *James Hodgson* has been at the Pains to calculate the Eclipses of the four Satellites of *Jupiter*, which were to happen in the Year 1732. It was to be wished he would continue to do so for the Years following; but I would advise him, to do it a long while beforehand, that People in Foreign Countries might have Time to be informed of it. He says, he has made use of Tables of the Satellites, which have not been corrected these 50 Years. \* Probably he means the Tables of M. *Cassini*, published at the Royal Printing-House at *Paris*, in 1693, at the End of the Observations of the Gentlemen of the Academy made in several Voyages. However, the late M. *Cassini*, has from Time to Time made divers Corrections to those Tables, though they never were made publick. M. *Maraldi* has also much worked at it after the Death of M. *Cassini*, and has communicated to me his Corrections, on which I have taken Pains to calculate new Tables; but having in the Year 1724, received of Dr. *Halley* a Copy of his Astronomical Tables, among which, are those of the four Satellites of *Jupiter* by Mr. *Bradley*, I judged there could not be any better, till some Method shall be found and explained geometrically to deduce from the Laws of Gravity, the Effect of the mutual Attraction of these Satellites on one another, and with relation to Ju-

\* He means Tables of the late Mr. Flamsteed.

*piter* : But as I could not hope this could be done so soon, I took the Pains again to calculate new Tables upon those of Mr. *Bradley*, by reducing the Tables of the four Satellites into the same Form with those Mr. *Pound* has made of the first Satellite only. These Tables being thus made easy, I have used them hitherto for comparing Observations; and my Brother has taken the Pains, since the drawing up those Tables, in the said Manner, to calculate a Year beforehand all the Eclipses of the four Satellites. I commonly sent those Calculations to my Correspondents, to prepare them for Observations, and some Years of those Ephemerides have been published in the *little Gazette of Literature of Leipzig*, printed in *High Dutch*. My Brother lately prolonged these Calculations to the Month of *January*, 1737.

Herewith follow the last Observations on the Satellites of *Jupiter*, which were made at *Petersburg*, since those inserted in the 3d Volume of the Memoirs of the Academy of *Petersburg*, to the present Time.

Immersion

N. St.	True Time.	
1731. Dec. 6.	17 <sup>h</sup> 3' 5''	Immersion of the First Satellite difficultly observed with a reflecting Telescope of 5 Foot. The true Time was found only by means of two Clocks.
1732. Jan. 4.	13 30 56	Immersion of the Second by the Reflector, doubtful to a few Seconds. <i>Jupiter</i> not being well defined nor sufficiently high. The true Time adjusted by two Clocks.
9.	18 33 7	Immersion of the Fourth by the Reflector. The Sky not very serene, and the true Time adjusted only by two Clocks.
	20 25 0	The other Satellites disappearing by the Day-Light, the Fourth was not yet come out of the Shadow. Telescope the same.



N. St.	True Time.	
Feb. 22.	13 <sup>h</sup> 25' 34"	The First Satellite, just entering the Shadow, was yet visible when a Mist covered <i>Jupiter</i> .
	13 26 34	<i>Jupiter</i> being uncovered the First Satellite did not now appear through the Reflecting Telescope. The true Time was adjusted only by two Clocks.
March 8.	8 22 20	Immersion of the Third by the Reflecting Telescope. The Wind was somewhat troublesome, the true Time was adjusted by two Clocks.
April 3.	8 46 23	Emersion of the First by the Reflecting Telescope. Doubtful to a few Seconds, by reason of the nearness of the Satellite to <i>Jupiter</i> .
13.	7 20 30	Immediately after Sunset, <i>Jupiter</i> becoming visible to the Eye, the Third Satellite appeared to be out of the Shadow,

N. St.	True Time.	
<i>April</i> 13.	7 <sup>h</sup> 20' 30''	dow, and entirely clear by the Reflecting Telescope.
20.	11 6 52	Emersion of the Third Satellite, by the Reflecting Telescope. The Sky Serene.
27.	15 13 00	The Third Satellite had been come out of the Shadow perhaps for several Minutes; for the other Satellites did not appear better than this which was seen with the Reflecting Telescope through the Mist, <i>Jupiter</i> being low, and the <i>Crepusculum</i> strong.
<i>May</i> 10.	12 55 54	Emersion of the First by the Reflecting Telescope. Sky Serene. Observation certain.
26.	11 14 5	Emersion of the First by a Telescope of 13 Foot. Cloudy.
<i>Dec.</i> 24.	18 4 30	Immersion of the 1st by a Telescope of 13 Foot. A good Observation.